Figure II-7-35. Photograph of physical model, Barbers Point Harbor, HI (Briggs et al. 1994)

g. Open basins - Helmholtz resonance.

(1) A harbor basin open to the sea through an inlet can resonate in a mode referred to as the Helmholtz or grave mode (Sorensen 1986b). This very long period mode appears to be particularly significant for harbors responding to tsunami energy and for several harbors on the Great Lakes that respond to long-wave energy spectra generated by storms (Miles 1974; Sorensen 1986; Sorensen and Seelig 1976).

(2) Water motion characterizing the Helmholtz mode is like that of a Helmholtz resonator in acoustics. It is analogous to the spring-mass system with one degree of freedom, discussed earlier in this section, where the spring is similar to the basin water surface and the mass represents water in the inlet channel. During Helmholtz resonance, the basin water surface uniformly rises and falls while the inlet channel water oscillates in and out. The period of this mode is greater than the fundamental mode. The resonant period is given by (Carrier et al. 1971).